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ANN BAVENDER*
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ANNE GOODWIN CRUMP
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EUGENE M. LAWSON, JR.
MITCHELL LAZARUS
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RAYMOND J. QUIANZON
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JAMES P. RILEY
ALISON J. SHAPIRO
KATHLEEN VICTORY
JENNIFER DINE WAGNER*
LILIANA E. WARD
HOWARD M. WEISS
*NOT ADMITTED IN VIRGINIA

FLETCHER, HEALD & HILDRETH, P.L.C.
ATTORNEYS AT LAW
11th FLOOR, 1300 NORTH 17th STREET
ARLINGTON, VIRGINIA 22209-3801

OFFICE: (703) 812-0400
FAX: (703) 812-0486
www.fhhlaw.com

RETIRED MEMBERS
RICHARD HILDRETH
GEORGE PETRUTSAS
CONSULTANT FOR INTERNATIONAL AND INTERGOVERNMENTAL AFFAIRS
SHELDON J. KRYS
U. S. AMBASSADOR (ret.)
OF COUNSEL
EDWARD A. CAINE*
DONALD J. EVANS
EDWARD S. O'NEILL*
WRITER'S DIRECT

703-812-0403
feldman@fhhlaw.com

July 1, 2002

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FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

VIA HAND DELIVERY
Marlene H. Dortch, Esquire
Secretary
Federal Communications Commission
445 12th Street, S.W., Room TWB204
Washington, DC 20554

Attn: Wireless Telecommunications Bureau

Re: Consolidated Opposition of Cornell University to Petitions for Reconsideration
WT Docket No. 00-32

Dear Ms. Dortch:

Transmitted herewith on behalf of Cornell University are an original and four copies of its Consolidated Opposition to Petitions for Reconsideration filed in the above-referenced proceeding.

If questions arise, please contact me.

Sincerely,

Paul J. Feldman
Counsel for Cornell University

Enclosure

cc: Certificate of Service
Patricia McClary, Esquire

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Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of	)	
	)	
The 4.9 GHz Band Transferred from Federal Government Use	)	WT Docket No. 00-32
	)	

CONSOLIDATED OPPOSITION OF CORNELL UNIVERSITY TO PETITIONS FOR RECONSIDERATION

CORNELL UNIVERSITY

Paul J. Feldman
Its Attorney

FLETCHER, HEALD & HILDRETH, PLC
1300 North 17th Street
11th Floor
Arlington, Virginia 22209
(703) 812-0400

July 1, 2002

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Before the
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CONSOLIDATED OPPOSITION
OF CORNELL UNIVERSITY
TO PETITIONS FOR RECONSIDERATION

Cornell University, by its attorney, hereby submits its Consolidated Opposition to the Petitions to Reconsideration filed by Microwave Radio Communications ("MRC") on May 8, 2002 and by the Los Angeles County Sheriff's Department ("LASD") on May 9, 2002 in the above-captioned proceeding. As shown below, the Commission's ban on aeronautical operations in the 4940-4990 MHz ("4.9 GHz") band in order to protect radio astronomy observations was appropriate and consistent with the record in this proceeding. Furthermore, MRC's requested clarification of Section 90.423 has excluded reference to a portion of that rule which appears to directly contradict the aeronautical use requested, and there is no evidence that Section 90.423 was intended for this sort of situation, where domestic and international footnotes prohibit the use sought. However, Cornell would not oppose the use of 4940-4950 MHz for aeronautical use, subject to appropriate out-of-band emission protections. Accordingly, the Commission should deny the LASD and MRC petitions as applied to 4950-4990 MHz.

I. Introduction

Cornell has a substantial interest in this proceeding, as it operates the Arecibo Observatory ("Arecibo" or "Observatory") in Arecibo, Puerto Rico. Arecibo is part of the National Astronomy and Ionosphere Center ("NAIC"), a national research center operated under a cooperative agreement with the National Science Foundation ("NSF"). The NSF is an independent federal agency whose aim is to promote scientific and engineering progress in the U.S. Additional funding for Arecibo is provided by the National Aeronautics and Space Administration ("NASA").

As the site of the world's largest single-dish radio telescope, Arecibo is recognized as one of the most important centers in the world for research in radio astronomy and planetary radar. Arecibo has been operating since 1963, and in 1997 work was completed on a multi-million dollar upgrade of the facilities, which significantly expanded the range and sensitivity of the observations that could be made, while increasing the shielding around the telescope in an attempt to reduce interference from ground radiation. The telescope now operates up to 10 GHz.

Arecibo has a long history of being the site where very significant accomplishments in astronomy have occurred, including:

- the first discovery of planets outside of our own solar system;
- discovery of the first pulsar in a binary system, leading to important confirmation of Einstein's theory of gravitational waves and a Nobel Prize for two radio astronomers who performed their research at Arecibo; and
- discovery of the correct rotation rate of the planet Mercury, as well as the discovery of ice in craters on Mercury's polar regions (and similar investigation of the polar regions of the Earth's Moon).

Yet, as the Commission knows, this uniquely important and expensive scientific instrument is extremely vulnerable to interference from unwanted emissions. *See, e.g.*, Radio Astronomy Coordination Zone in Puerto Rico, Report and Order, 12 FCC Rcd 16522 (1997). It is for this very reason that the Commission has enacted Quiet Zone rules specifically protecting Arecibo, and making Arecibo a Quiet Zone Entity. *See* Section 1.924(d) of the Commission's Rules.

II. The Record in this Proceeding Supports a Ban on Aeronautical Use of the 4.9 GHz Band.

Of particular concern in this proceeding is protection of Radio Astronomy Service ("RAS") observations in the 4.9 GHz band. The need for protection of observations in this band is quite valid. Such observations are important for studying the brightness distributions of galactic and extra-galactic objects such as ionized hydrogen clouds, supernova remnants and the relativistic jets. These observations allow scientists to construct detailed maps of such phenomena, to understand their structures and dynamics, and to derive physical parameters from the sources, such as their total masses. Observations of relativistic objects from neutron stars and black holes are particularly vulnerable to interference due to variability, and one cannot just re-observe such phenomena at a later time.

The Second Report and Order in this proceeding ("*2nd R&O*")[1] properly recognized the need to protect RAS observations at 4.9 GHz, and properly concluded that aeronautical transmissions in this band posed a significant threat of interference to

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[1] FCC 02-47, released February 27, 2002. The same document also contained a Further Notice of Proposed Rulemaking ("*FNPRM*").

those observations. *Id.* at paragraph 9. Contrary to the assertions of MRC (Petition at page 5) and of LASD (Petition at page 2-3), there is substantial and sufficient evidence in the record to support this finding. First, the *2nd R&O* properly acknowledged the footnote protection given to the Radio Astronomy Service in this band. As noted in paragraph 3, international footnote S5.149 provides that "administrations are urged to take all practicable steps to protect the radio astronomy service from harmful interference, " because "emissions from spaceborne or airborne stations can be particularly serious sources of interference to the radio astronomy service."[2] Similarly, the *2nd R&O* acknowledges that footnote US257 previously provided, and footnote US311 currently provides, that "every practicable effort will be made to avoid the assignment of frequencies in this band to stations in the aeronautical mobile service ... which may cause harmful interference to the listed observatories."[3] These footnotes are based on widely recognized scientific calculations, and are the result of international negotiations at World Radio Conferences. For both of these reasons, the Commission cannot ignore the footnotes, and in fact, the footnotes provided the core basis for the Commission's decision to prohibit aeronautical use in the 4.9 GHz band. *See 2nd R&O* at paragraph 9. The footnotes alone provide a sufficient basis for the Commission's ban on aeronautical use.

However, there was additional evidence in the record that formed the basis of the ban on aeronautical use. First, as the Commission recognized, this band was

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[2] *2nd R&O* at para. 3, *citing* Table of Frequency Allocations, 47 C.F.R. Section 2.106.

[3] *Id..*, *citing* Table of Frequency Allocations, 47 C.F.R. Section 2.106.

originally allocated solely for government use, and when it was reallocated for private use, one explicit condition on the reallocation set by the Department of Commerce was that the band would not be used for aeronautical transmissions at 4950-4990 MHz.[4] Again, this condition on reallocation was solidly based on science, and could not be ignored by the Commission.

The record also contained the Comments filed by the National Academies' Committee on Radio Frequencies ("CORF") on April 26, 2000 and on December 19, 2000. In the December 2000 Comments, CORF provided the calculations demonstrating the potential impact of transmissions in the 4.9 GHz band on radio astronomy observations.

In sum, the domestic and international footnotes, and the filings made by CORF and the Department of Commerce, provided a substantial and sufficient basis for the ban on aeronautical use of the 4.9 GHz band in the *2nd R&O*. Accordingly, there is no validity to the assertion of MRC (Petition at page 5) and of LASD (Petition at page 3) that the ban on aeronautical use is not supported by the record in this proceeding.

III. Cornell Opposes MRC's Proposed "Clarification" of Section 90.423 of the Commission's Rules.

As an alternative to reconsideration of the ban on aeronautical use enacted in the *2nd R&O*, MRC seeks a clarification of Section 90.423 of the Commission's rules which would allow aeronautical use in the entire 4.9 GHz band. However, MRC has

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[4] *2nd R&O* at paragraphs 3 and 9, *citing* March 30, 1999 Letter from Larry Irving, Assistant Secretary for Communications, United States Department of Commerce, to William Kennard, Chairman, FCC (*"Reallocation Letter"*), and *citing*, *Transfer of 4.9 GHz Band From Federal Government, Notice of Proposed Rulemaking*, 15 FCC Rcd 4778, 4788 (2000).

excluded reference to a portion of Section 90.423 which appears to directly contradict the requested clarification. Furthermore, MRC provides no evidence that Section 90.423 was intended for this sort of situation. Lastly, MRC's requested clarification would be inappropriate in a situation such as this, where domestic and international footnotes prohibit the use sought through clarification of a completely different rule.

Section 90.423(a) states in part that

> except as may be provided in other sections of this part with respect to operations on specific frequencies, mobile stations ... may be operated aboard aircraft for air-to-mobile, air-to-base, air-to-air, and air-to-ship communications subject to the following: (1) Operations are limited to aircraft that are regularly flown at altitudes below 1.6 km (1 mi) above the earth's surface; (2) Transmitters are to operate with an output power not to exceed ten watts; (3) Operations are secondary to land-based systems; (4) Such other conditions, including additional reductions of altitude and power limitations, as may be required to minimize the interference potential to land-based systems. (emphasis added)

Cornell notes that while the rule language emphasized above was left out of MRC's recitation of the rule, such language is particularly important in this case. There appears to be two possibilities for how mobile uses of the 4.9 GHz band will be regulated: Part 90 or Part 27. *See FNPRM* at para. 41. If the service is to be regulated as a Part 27 service, then Section 90.423(a) is not applicable, and the requested clarification is irrelevant. If the service is to be regulated under Part 90, then the emphasized language prohibits the proposed clarification. That is, since the *2nd R&O* specifically prohibits aeronautical use of the 4.9 GHz band, the "exception" language in 90.423(a)

and emphasized above is triggered, and constitutes a prohibition that trumps the aeronautical use that might otherwise be available under Section 90.423(a).[5]

In addition to the barrier of the exception language in Section 90.423(a), there is no evidence that Section 90.423(a) was intended to be used in this sort of circumstance. First, as the Commission recognized in paragraph 3 of the *2nd R&O*, both an international and a domestic footnote urge the Commission to avoid aeronautical uses in the 4940-4950 MHz portion of the band. Certainly, when the Commission enacted Section 90.423(a), it did not intend the rule to be used to circumvent allocation footnotes. Furthermore, these footnotes were a major basis for the prohibition on aeronautical use just enacted by the Commission in this proceeding, and it makes no sense to allow circumvention of that action by reference to the rarely-used rule Section 90.423.

IV. Other Arguments Provided for Reconsideration Are Invalid.

As discussed above, there is no validity to arguments in the Petitions that the record does not support the ban on aeronautical use. Furthermore, the requested clarification of Section 90.423(a) seems to contradict language in that rule section and

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[5] Cornell also asserts that the language in Section 90.423(a)(4) stating that aeronautical use is to be "secondary to land-based systems" suggests that airborne use in the entire 4.9 GHz band would be prohibited under that rule section, due to potential interference to radio astronomy observatories. Cornell is aware of the decision of the Wireless Telecommunications Bureau in City of Los Angeles et. al., Order, DA 01-160 (released January 24, 2001), in which the Bureau held that this rule section did not make airborne use in the 2.4 GHz band secondary to Part 74 broadcast facilities. However, the ruling in paragraph 8 of that *Order* was explicitly restricted to the narrow question of the relationship between Section 90.423(a)(4) and Part 74 facilities, and does not apply to the relationship with the RAS. The rationale for the ruling was based on the obligation of Part 74 facilities to avoid radio interference to safety-of-life radio communications. Radio astronomy observatories do not make such interfering transmissions. Furthermore, in the situation addressed in the *Order*, the Part 74 service did not have the footnote protection that the RAS has in this case.

in allocation footnotes. Most other arguments for reconsideration in the Petitions are equally invalid.

On page 4 of its Petition, LASD asserts that the Commission should have considered options for protection of radio astronomy sites other than a complete ban on aeronautical use, including "geographic limitations, limitations on the altitudes from which the aeronautical mobile signals could be transmitted, limitations on duration of aeronautical mobile transmissions, the use of directional antennae, and other interference-limiting technologies, spectrum sharing arrangements, frequency coordination and waiver provisions." The core problem with each of these proposals is that they would contradict the prohibitions set forth in the domestic and international footnotes cited above, and also contradict the condition of reallocation established by the Department of Commerce. On this basis alone, they should be rejected. However, each of these proposals has additional flaws:

- *Geographical Limitations:* It is not clear what sort of limitations that LASD is referring to, but Cornell notes that in paragraph 17 of the *2nd R&O*, the Commission rejected the use of geographical coordination/exclusion zones as a means of protecting radio astronomy observatories. While Cornell supported the use of such zones for protection against interference from terrestrial fixed and mobile operations, it would oppose them for aeronautical uses. While any geographical area excluding aeronautical use would have to be significantly larger than the zones in footnote US311 in order to account for the greater distance traveled by airborne transmissions, Cornell believes that no single rule could properly account for differing altitudes of and topography surrounding the 15 radio astronomy sites listed in US311. Since these factors (along with the altitude of the transmitting vehicle) would determine the distance necessary to provide the required protection, it is unlikely a rule with a single separation distance could properly proper protect each of the RAS sites.

- *Limitations on Transmission Altitude*: The core problem of trying to set an altitude limitation to protect 15 different observatory sites is similar to the problem with establishing a geographical limit to protect those sites: each site is sitting at a different altitude, with different surrounding topography, and thus no single altitude limitation could properly address those differing situations.

- *Use of Directional Antennae:* Based on the mere off-hand suggestion in the LASD and MRC petition, it is hard for Cornell to understand how this would be a solution. A directional antenna for a video link from an aeronautical mobile unit such as a "scene management" helicopter to a base command station is unlikely to limit its transmissions to a narrow direction. The expected flight pattern is typically circuitous, and therefore maintenance of antenna gain from the mobile unit in the direction of the base station (in spite of rapid changes in direction, altitude, pitch and roll) would appear to either require near omnidirectional transmission, or to result in such omnidirectional transmission. If so, one cannot appeal to the benefit of a directional antenna of an aeronautical mobile transmitter to limit power emitted in the direction of a radio observatory in the manner that is possible with fixed stations.

- *Spectrum Sharing Arrangements*: It is unclear what LASD means by this. If LASD is proposing that the sharing be based on each party using different times of the day, then this seems impractical for the public safety community, since emergencies can occur at any time of day. If LASD is suggesting that different parties can use the same frequency at the same time, then doing so would make sense only if there were other means of insuring that the aeronautical use did not interfere with radio astronomy observations. However, as discussed here, those other means appear to be flawed.

- *Frequency Coordination*: Again, this approach appears impractical for the public safety community. If "coordination" means agreement in advance when and how aeronautical uses would occur, then this advance planning seems to be inconsistent with the idea that aeronautical transmissions are necessary in order to assist public safety agencies in addressing emergencies, which occur without notice rather than at pre-arranged times.

- *Waiver Provisions*: As is the case with frequency coordination, generally a waiver is sought in advance of violation of a rule, but such action in advance cannot address unplanned emergencies.

In sum, the alternatives proposed by LASD do not appear to solve the problem, either for public safety agencies, or for radio astronomy observatories. Similarly flawed is the citation by MRC (on page 5 of its Petition) to language in the *2nd R&O* wherein the Commission stated that terrestrial fixed and mobile use of the 4.9 GHz band should not cause significant impact on radio astronomy, "given the small number and remote location of radio astronomy observatories." While the Commission may have come to that conclusion in connection with terrestrial use of the 4.9 GHz band, as shown above, aeronautical transmissions raise significantly different issues, given the fact that aeronautical transmissions travel a much greater distance than terrestrial transmissions.

V. Cornell Would Not Oppose Aeronautical Transmissions at 4940-4950 MHz.

As shown above, the record in this proceeding supports the Commission's complete ban on aeronautical transmissions, as a proper means of protecting radio astronomy observations. Furthermore, the proposals in the Petitions for means by which observations would allegedly be protected from aeronautical transmissions at 4950-4990 MHz are impractical or otherwise flawed. Nevertheless, in recognition of the important work done by public safety agencies, Cornell would not oppose aeronautical transmissions at 4940-4950 MHz, assuming that appropriate technical standards are enacted to protect against damaging out-of-band and spurious emissions from such aeronautical use. Such an approach would give public safety agencies some aeronautical use of the 4.9 GHz band, while significantly reducing the risk of interference to radio astronomy observations, since the 4940-4950 MHz portion of the

4.9 GHz band is the portion farthest away from protected RAS frequencies, thus providing the least risk for out-of-band and spurious emissions.

VI. Conclusion

The Commission's ban on aeronautical operations in the 4.9 GHz band in order to protect radio astronomy observations was proper and follows from the record in this proceeding. Furthermore, MRC's requested clarification has excluded reference to a portion of Section 90.423 which appears to directly contradict the aeronautical use requested, and there is no evidence that Section 90.423 was intended for this sort of situation, where domestic and international footnotes prohibit the use sought. However, Cornell does not oppose the use of 4940-4950 MHz for aeronautical use, subject to appropriate protections against damaging out-of-band and spurious emissions. Accordingly, the Commission should deny the LASD and MRC petitions as applied to 4950-4990 MHz.

Respectfully submitted,

CORNELL UNIVERSITY

Paul J. Feldman
Its Attorney

FLETCHER, HEALD & HILDRETH, PLC
1300 North 17th Street, 11th Floor
Arlington, Virginia 22209
(703) 812-0400

July 1, 2002

CERTIFICATE OF SERVICE

I, Joan P. George, a secretary in the law firm of Fletcher, Heald & Hildreth, do hereby certify that a true copy of the *Consolidated Opposition of Cornell University to Petitions for Reconsideration* was sent this 1st day of July, 2002 via United States First Class Mail, postage prepaid, to the following:

Todd D. Rosenberg
O' Melveny & Myers LLP
1650 Tysons Boulevard
McLean, VA 22102

Anthony Finizio
President
Microwave Radio Communications
101 Billerica Ave - Bldg 6
North Billerica, MA 01862

Jeffrey Krauss
Telecommunications & Technology Policy
620 Hungerford Drive, Suite 27
Rockville, MD 20850

Joan P. George